winds being to westerly as 8 to 3—a relation which could not hold if prevailing winds in this region were westerly. At Copenhagen the direction is S.S.W. In accordance with these facts the rainfall of the west of Scotland is much greater than that of the west of Norway.

Mr. Laughton maintains that there is, throughout the sea, no trace whatever of the air being drawn in to any place of greatest heat, &c. (p. 303), and adduces many instances in support of this opinion; but, curiously enough, every case adduced confirms the opposite view. This arises from a misapprehension of the principle involved in Buys Ballot's Law of the Winds, which may be thus put: Winds flow in towards the space where pressure is weak, vorticosely, so that in the N. hemisphere, standing back to the wind, the weak pressure is to the left. To take one case as an illustration:—Because the winds at Aden and south of Arabia do not blow directly in upon the heated sands of that region, but blow from W.S.W., it is concluded that there is no trace whatever in this part of the sea of the heated air influencing the winds. Now, if it be the case that there is at this season a weakening of the pressure by an ascending current of heated air from the surface of Arabia, then, according to Buys Ballot's law, the direction of the wind ought to be what observation shows it is, viz. W.S.W., and the more powerful the ascending current, the stronger will be the W.S.W. winds on the surface.

Mr. Laughton regards it as established presumptively that a westerly upper current everywhere prevails (p. 97). This he has shown generally to be the case as respects upper currents of tropical regions and a portion of the United States, but not as respects other parts of the globe. The explanation of these upper currents is easy. If the pressure of the atmosphere, at a uniform height of say, 10,000 feet, were ascertained, the highest would be immediately over the belt of calms, and the lowest over those regions where the mean temperature of the whole stratum, 10,000 feet thick, happens to be the lowest; this result being a simple consequence of the increased tension of air by heat, and diminished tension by cold. Since the pressure at the height supposed will continually diminish on receding from the Equator on either hand, it follows from Buys Ballot's Law that the prevailing upper currents ought to be westerly within the tropics, or, stated more exactly, W. by S. north of the Equator, and W. by N. south of it. It is during the winter months that westerly upper currents prevail in the United States. Since during this season the mean temperature rapidly sinks in advancing northwards over America, atmospheric pressure will be much weaker over British America at a height of 10,000 feet than over the United States, and hence by Buys Ballot's Law the upper current of the United States ought to be westerly. It may be remarked that since westerly upper currents are flowing towards colder regions, condensation of their vapour into cloud must frequently take place, thus rendering them visible; whereas since easterly currents flow towards warmer regions, condensation will seldom take place, and hence they must frequently flow past unobserved.

The broad zone included between latitudes 30° N. and S. comprises half the superfices of the globe. Over by far the greater portion of this zone winds are easterly, there being no season when any approach to a preponderance of westerly winds is apparent. When to these are added the easterly winds in extra-tropical regions, already referred to, a predominance of easterly winds in the north of Siberia and in the east of Australia, in their respective summers, and in a large part of the Arctic regions at all seasons; and though not a predominance yet the frequent occurrence, of easterly winds in the S. hemisphere, south of latitude 50°, it is plain that if there can be a preponderance of westerly winds over the globe viewed as a whole, it cannot be very great. A. B.

THE SEWAGE QUESTION

The Practical Solution of the Great Sewage Question, by a Combination of the Irrigation and Precipitating Processes. By William Justyne. (John B. Day.)

IN this little book the author tries to show that the A B C process is the only one which promises any hope of success among the methods which have been proposed or adopted for purifying sewage and utilising its valuable manurial constituents. "Miscellaneous schemes," including the dry-earth system, Liernur's process, and all the precipitation plans, except the favoured one, are dismissed very summarily, and the irrigation system is made to look as unsuccessful and as dangerous as its opponents have ever represented it to be, while the immense weight of indubitable facts and evidence on the other side is entirely passed over.

Then the A B C process is minutely described, and the scientific public is asked to believe that sewage, which contains suspended and dissolved organic and inorganic matters, and the chief value of which consists in the large amount of dissolved nitrogen, especially in *the form of ammonia*, which it contains, can be so purified by precipitation with a mixture of alum, blood, clay, animal charcoal, and what not, as that the effluent water shall contain no putrescible matter, and that the *precipitate* shall contain the manurial constituents!

What we do know with regard to the A B C and all other precipitating processes is, that they none of them separate out anything like all the dissolved (few of them nearly all the suspended) organic matters, and that the ammonia is necessarily all lost in the effluent water; indeed, several of these processes have been known actually to increase the amount of ammonia in the effluent water, by decomposing some of the organic matters. The only precipitating process which had the merit of attempting to throw down the ammonia was the phosphate process, which has been tried and abandoned so many times in this and other countries; the reason of its failure was very simple: the ammonio-magnesian phosphate which it was expected would be found in the precipitate, requires an excess of ammonia in the solution to render it at all insoluble, so that if any of this salt were contained in the sediment it would merely show that the effluent water still contained an excess of ammonia.

We must comment especially upon two points in which a person seeking for information is likely to be misled as to matters of fact by consulting this book. On page 17 we observe a table of the average percentage composition of solid and fluid human excreta, from which one might easily be led to suppose that the solid is more valuable than the fluid (as it is *weight for weight*), but we nowhere

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find the important fact added that since for every ounce of solid excreta we have about 10 ounces of liquid, the total liquid excreted in a given time is worth about seven times as much as the total solid: so that as far as utilisation is concerned, the question which has to be solved is, how to deal with the liquid and its valuable constituent urea, or rather carbonate of ammonia, for it is as such that we find it in sewage.

The other point is the statement at the bottom of page 56, that "the analysis of the effluent water, after the sewage has been treated by the A B C process, is an analysis of the effluent water *solely;* whereas in almost every case where analyses have been made of the effluent water after the irrigation process, the effluent water has been diluted by at least double and sometimes three and four times its bulk, with perfectly pure spring and subsoil water." But then, how is it that the effluent water is, except during very wet weather, so very much less in quantity than the sewage sent on to the land? Mr. Justyne does not tell us this—we will tell him; it is because three-fourths, sometimes four-fifths, sometimes much more of the water has disappeared by evaporation from the leaves of the growing plants, and to a certain extent from the surface of the ground itself, so that to compare fairly the composition of the effluent water of the A B C process with that of an irrigated field, we must dilute the latter with distilled water until its bulk is equal to that of the sewage sent on to the land; even without this correction, the purity of the effluent water from irrigated lands has never been approached by any other method; with this correction, we think we may safely say that it is never likely to be approached.

Our author suggests that irrigation with the effluent water should be practised, when necessary, as a secondary and subordinate operation to the precipitation process; we submit that it has never yet been shown that it would not always be necessary to irrigate with this effluent water, both from a sanitary and an economical point of view, and it is plain that if to purify sewage, irrigation must be resorted to, any preliminary process which separates more than the offensive suspended matters, must be disadvantageous, by lessening the value of the liquid sent on to the land.

That the suspended matters should be to a great extent separated before the sewage is sent on to the land, we hold to be indisputable, but this should be done by some simple method, which leaves the sewage as *rich as possible* in dissolved manurial constituents.

In conclusion, from a chemical point of view, we object to reliance being placed on any precipitation process for the removal of its valuable constituents from sewage, and from a sanitary point of view we object to the effluent water from precipitation tanks being sent at pleasure into streams whose water is afterwards used for domestic purposes.

W. H. C.

OUR BOOK SHELF

The Honey Bee; its Natural History, Physiology, and Management. By Edward Bevan, M.D. Revised, Enlarged, and Illustrated by William Augustus Munn, F.R.H.S., &c. (Van Voorst, 1870.)

In this new edition of Dr. Bevan's well known work, Major Munn has given a full account of all the improved hives and methods of management, and of the most recent discoveries in the economy and physiology of bees. The old and the new matter are, however, so interwoven, that it is impossible for the reader to separate them; and as the original author and his editor both speak in the first person, we find ourselves continually at a loss to know whether we are reading "Bevan" or "Munn," except in those cases where some reference to dates enables us to decide.

An interesting experiment is detailed, proving that the business of a hive may go on a long time with perfect regularity without the presence of a queen. On the 13th June a swarm was put into a mirror hive. On July 1st, whilst the queen was laying drone eggs, she was taken away, yet the bees showed no agitation, but continued their work as usual. They formed several royal cells, and examined them continually to see if eggs had been deposited in them. All through the summer work went on as usual, honey being plentifully stored; but no attempt was made to raise a queen by artificial food, nor were the drones massacred. By the middle of November all the drones had died, and the working bees then began to diminish, and by December 31st they had also died. As all the workers had been born before July 25th, this gives about six months, or not much less, for the duration of their lives.

The fortifications and barricades of the bees against the incursions of the Death's Head Moth are said to be due to reason rather than to instinct, because it has been observed that they do not commence these fortifications on a first attack of the Sphinx, nor until they have been robbed of nearly their whole stock of honey. "This is a case in which the insect is taught by experience, and which admits, in all its particulars, of a direct comparison with human reason and contrivance. A colony that had been thus attacked one year, and was tardy in its defensive operations, having derived instruction from the past, constructed fresh ramparts speedily on the reappearance of the Sphinx three years afterwards, and thus guarded itself from an impending danger. Since the lives of the working bees do not extend beyond six or seven months, it is evident that the information of the colony above referred to must have been traditional, or else derived from a queen which had reigned over them three years previously." This "tradition" through some six or seven generations seems highly improbable, and that the knowledge of how to act was derived from a queen not less so. Do not the facts rather indicate that bees differ considerably in intellectual capacity, and that some hives contain directing bees more capable of acting promptly on the defensive than others?

Much information is given on the different kinds of foreign bees, and their peculiar modes of building. The importance of bees in fertilising flowers, and the use of nectar and of the colours of flowers as attractions, are fully recognised; but the recent discoveries of Darwin on this subject are not alluded to. So, in the discussion on the hexagonal form of the cell, the "circular" theory is opposed, and Mr. F. Smith is quoted against it; but the beautiful experiments of Mr. Darwin, as described in the "Origin of Species," with the satisfactory theory founded upon them, appear to be unknown to the author. "Darwin," it is true, is very frequently quoted, but it is always Doctor, not Charles, Darwin.

The book is illustrated by woodcuts of the various kinds of hives, and of the apparatus used by Apiarians. There are also some very scratchy but characteristic etchings of the different kinds of bees and of their anatomy, and several coarse coloured lithographs of varieties of comb, royal cells, &c., all executed by Major Munn himself. Though with some deficiencies of style and arrangement, the work abounds with information useful to the bee-keeper, and interesting to the naturalist.

ALFRED R. WALLACE

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